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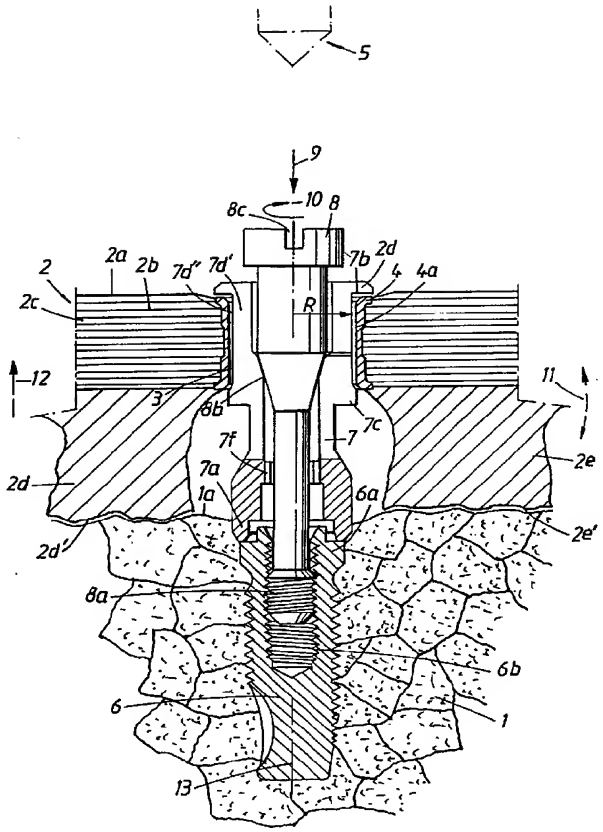
[Continued on next page]

(54) Title: DEVICE FOR DETERMINING POSITION



(57) Abstract: A device for determining the position of a sleeve, on the one hand in the vertical direction in relation to a fixture dummy (6) in or on a model (1) of a bone, and on the other hand in the transverse direction in relation to the longitudinal axis (13) of the fixture dummy. An expansion spacer (7) cooperates with the fixture dummy and the sleeve (4). An expansion screw is designed in such a way that, when acted upon, it in turn acts upon the expansion spacer so that the latter determined the position of the sleeve and thus of the template relative to the jaw bone and the fixture.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Device for determining position.

The present invention relates to a device for determining the position of an element, for example a sleeve, on the one hand in the vertical direction in relation to an anchoring part or structural part, for example a fixture or fixture dummy, in or on a bone, for example a jaw bone, or a model of a bone, and on the other hand in the transverse direction in relation to the longitudinal axis of the part.

The invention is intended, inter alia, to be used in connection with the production and the use of assembly templates which are used for hole-forming means (drill/drills, attachments, etc.) in the jaw bone. The assembly template can be used in connection with a model of the jaw bone and/or in connection with the patient's jaw bone. The invention can be more specifically used on templates or assembly templates which are made of carbon fibre-reinforced plastic, where the assembly template material has a certain formability during production of the template. The template is in an initial stage produced with the aid of a shell and carbon fibre wires arranged in the latter. Matrix material is injected into the shell (tube). In connection with the application to the jaw-bone model, through-holes must be able to be arranged in the bridge material so that guide sleeves can be applied in the holes thus formed and constitute guide members for said hole-forming means.

The assembly template can also be shaped so that it bears on the gum where in some cases it can be in contact with the jaw bone via horizontally lying pins which touch the top of the jaw bone or dental crest. The invention also relates to the anchoring of such an assembly template.

Reference is made, inter alia, to Swedish Patent

457,691 which describes the production of oral and extra-oral prosthetic constructions made of composite material with a considerable fibre content.

Reference is also made to the Swedish patent application filed by the same Applicant and relating to a device or arrangement for applying sleeves in holes in connection with, inter alia, assembly templates for dental bridges or other tooth replacement fittings. The title of said application is "Device for forming holes and inserting sleeves in a unit incorporated in a dental attachment part".

In connection with the production of the assembly template in question or another auxiliary device of this type, it is expedient to keep the parts of the template or the like in a well-fixed spatial position in relation to an actual fixture or fixture dummy. In said position-determining function, there must be great precision both as regards the vertical position and the lateral displacement position in relation to the fixture or the dummy. In one embodiment, the sleeve or the like in question must assume a position above the fixture or the fixture dummy, which position can be concentric in relation to the longitudinal axis of the fixture or of the fixture dummy. The precision of said position or positions must prevail because the template, after its production on the jaw-bone model, must be able to be transferred to the patient and there assume a position in the patient's jaw bone which very accurately corresponds to the position which was present on the jaw-bone model. The invention aims to solve this problem among others.

With the assembly template material whose position has thus been determined in or on the jaw model, the assembly template must be able to be acted upon for changing shape or for material additions which means that the template is given support members which can

cooperate with an upper surface of the jaw-bone model, which upper surface corresponds to the surface of the patient's jaw bone. Said support members must be able to be given shapes and positions which, after removal of the position-determining members, allow the assembly template to maintain its precise position on the surface of the jaw bone model, and, upon transfer to the patient's jaw bone, the assembly template will be able, with the aid of the support members, to maintain a corresponding position which it assumes on the jaw-bone model. The irregularities in the surface of the jaw-bone model and in the patient's jaw bone in this case serve to obtain said position determinations in the transverse directions, and by means of said height-determining function the assembly template will be able to permit holes to be formed for fixtures in the patient's jaw bone in a position which very accurately corresponds to the position in or on the model. The accuracy can in this case be of the order of 0.05 mm. The invention solves this problem too.

The positional determination or fixing of the assembly template in question, with associated sleeves, to or on the jaw bone model must also be such that, when the template or template parts are screwed into or onto the jaw-bone model, it is not possible for the template or template parts, during the screwing or tightening, to permit changes in the position of the sleeves, which must not be allowed to tilt or otherwise change their positions in relation to the fixture dummy or fixture dummies during said tightening. The invention solves this problem too.

The feature which can principally be regarded as characterizing a device according to the invention is that a first member, for example in the form of an expansion spacer, cooperates both with the anchoring part or structural part, i.e. in the illustrative embodiment with the fixture or fixture dummy, and also

with said element/sleeve, and in that a second member, for example an expansion screw, is designed in such a way that, when acted upon, it in turn acts upon the first member/expansion spacer so that the latter determines the position of the element/sleeve.

Embodiments of the invention are set out in the attached subclaims. Thus, for example, the device can comprise an expansion spacer which is acted upon by the expansion screw such that outer surfaces of the expansion spacer which cooperate with opposite surfaces on the respective sleeve are displaced radially outward and, upon cooperation, assume a parallelism with the inner surface of the sleeve with a high level of accuracy.

By means of what is proposed above, a position-determining device is obtained which secures the assembly template in place without risks of the assembly template tilting or changing position on account of the tightening in the actual fixture dummy or fixture. In the position thus assumed with the device, the assembly template can thus be assigned supporting or cooperating parts via which the assembly template cooperates with the jaw-bone model in order to obtain, with a high degree of accuracy, a precise position of the surface in question. The device also has a comparatively technically simple construction and can, for example, work with an external cone on an expansion screw and an internal cone on the expansion surface so that the parallelism between the cooperating surfaces on the expansion spacer and the sleeve in the dental bridge is present and is maintained during the subsequent work on the dental bridge.

A presently proposed embodiment of a device having the features characterizing the invention will be described below with reference to the attached drawings, in which:

Figure 1 shows, in a vertical view and partial cutaway view, a position-determining device for an assembly template in a fixture dummy in or on a jaw bone model,

Figure 2 shows, in a horizontal view, parts of the jaw bone model and an assembly template extending thereon,

Figure 3 shows, in a vertical view and partial cutaway view, an expansion spacer included in the device,

Figure 4 shows, in a vertical view, an expansion screw which can cooperate with the expansion spacer according to Figure 3,

Figure 5 shows, in a side view, an embodiment of a sleeve fitted in the bridge, and

Figure 6 shows, in a horizontal view, the sleeve according to Figure 5.

Figure 1 shows a jaw-bone model labelled 1. The jaw-bone model represents a jaw bone of a patient. The model can be produced on different principles and thus, in one embodiment, the jaw model can be produced using stereolithography equipment known per se. An assembly template 2 is applied to the top surface 1a of the model. The assembly template is provided with a number of through-holes, of which one hole 3 is shown in the figure. The hole is obtained with the aid of a sleeve 4 which will constitute a guide member for a hole-forming member 5 shown diagrammatically or symbolically in connection with the template. The sleeve can be made of metal (titanium) or alloy. The template is secured in fixture dummies, of which one fixture dummy has been shown by 6 in Figure 1. The fixture dummy can be of a type known per se and available on the open market, for example from Nobel Biocare AB. The assembly template can consist of a shell 2a which includes carbon fibre

reinforcements 2b in a manner known per se. In addition, the shell contains matrix material 2c, for example acrylic plastic, which is injected inside the shell 2a. The template has been or is to be polymerized such that the template assumes a hardened form. The template is provided with cooperating members 2d and 2e which cooperate with said surface 1a on the jaw-bone model. The bottom surfaces 2d' and 2e' of the cooperating parts follow the contour of the top surface 1a with great precision so that the irregularities in said top surface 1a can be made use of as fixing or position-determining members when the template in the finished state is transferred to the patient's jaw bone. In or during the template production stage in which said cooperating members are established, it is important that the template can assume and maintain an exact position in relation to the fixture. According to the invention, this is achieved with the aid of position-determining members which comprise an expansion spacer 7 and an expansion screw 8. In the application procedure, the expansion spacer is pushed down through the recess 4a of the sleeve when the expansion spacer assumes a circumferential dimension which allows the spacer to be pushed down from above, cf. arrow 9, through the sleeve to make contact with the upper end 6a of the fixture dummy. The expansion spacer thus bears with its lower parts 7a against the upper parts 6a of the fixture dummy. The cooperating surfaces between the spacer and the dummy can be designed in a manner known per se, giving the spacer a distinct transverse position in relation to the fixture dummy. The pushing-down of the spacer in the sleeve is thus of an order of magnitude which means that two outwardly projecting flanges 7b and 7c on the upper parts 7d of the spacer can engage around the sleeve when the spacer is expanded radially outward at a stage after insertion. In the thus inserted position, the expansion screw 8 is applied from above, cf. arrow 9. The expansion screw is provided with a thread, in the

present case an external thread 8a, by means of which the screw can be screwed down in a corresponding internal thread 6b in the fixture dummy. In the present illustrative embodiment, the expansion spacer and the expansion screw can be pushed down at the same time through the recess 4a, i.e. the expansion screw assumes a preliminary position in the expansion spacer. The expansion spacer can in this case be provided with an internal flange 7f which prevents the expansion screw from separating from the expansion spacer upon handling. The expansion screw has an external cone-shaped part 8b, and the expansion spacer has an internal cone-shaped part 7e. Said cone-shaped parts cooperate with one another when the expansion screw is imparted rotational movements 10 relative to the spacer and is screwed down in the thread 6b. The cooperation between said cone-shaped parts means that portions 7d' of the upper parts of the expansion spacer are pressed radially outward, cf. radius R. The radial outward pressing ensures that outer surfaces 7d'' are pressed so as to bear against the inner wall 4a of the sleeve 4 so that the template is fixed or its position determined in relation to the fixture dummy. The radial outward pressing and internal clamping which are effected with the aid of the expansion spacer and the expansion screw mean that no tilting movements occur, for example the tilting movements indicated by broken-line arrows 11, 12. The common longitudinal axis of the fixture dummy and of the spacer and of the screw is indicated by 13. The determination of position achieved in accordance with the above means that the spacer and screw 7 and 8, respectively, can adopt said common longitudinal axis with great accuracy.

With the assembly template in the position thus accurately fixed in relation to the top surface 1a of the jaw-bone model, the final shape can thus be given to the assembly template.

In Figure 2, reference number 14 indicates a patient's upper jaw bone as seen from underneath. The bridge 2 according to Figure 1 has been transferred to said jaw and bears against its surface 14a with great accuracy by means of cooperating parts 2d and 2e which can be provided in a large number along the extent of the template 2 in the horizontal direction. The irregularities in the surface 14a can thus be used to fix the template in the transverse directions 15 and 16 relative to the jaw-bone surface 14a. In Figure 2, three sleeves arranged along the longitudinal extent of the template are indicated by 4', 4'' and 4'''. The cooperating parts can be made of silicone material in conjunction with or after the production of the template.

Figure 3 shows a detailed embodiment of an expansion spacer according to Figure 1. The expansion spacer defines, with its vertical dimension H, the position of the sleeve 4 above the dummy 6 (see Figure 1). In its upper half (related to Figure 3), the spacer has one or more slits which extend in the longitudinal direction of the spacer. In the preferred illustrative embodiment, there are two such slits 7g. The slits extend at least along the outer surfaces 7d'' which cooperate with the inner surface 4a of the sleeve 4 (see Figure 1). In a preferred embodiment, the slit or slits 7g extend along at least half or more than half of the length of the expansion spacer. The slit arrangement and the inner recess 7h for the expansion screw and the transitions between the inner wall of the recess and the internal cone-shaped part 7e are thus such that, when the expansion spacer is acted upon by the expansion screw via said cone-shaped parts 7e and 8b (see Figure 1), there is a substantially parallel displacement radially outward from the position shown in Figure 3. In connection with the parallel displacement, the side parts 7i assume the position 7d''' where the parallel cooperation takes place with

the inner surface 4a of the sleeve (see Figure 1). In one embodiment, the side surfaces 7d'' can be non-parallel with said inner surface 4a from the outset. In the radial displacement to the position 7d''', the surfaces 7d'' assume their parallel positions with 4a so that clamping from inside is obtained along the entire inner surface 4a. The spacer also has an outer portion 7a' which can be of a type known per se in accordance with the above, which portion cooperates with the corresponding top side of the fixture dummy known per se. Said portion 7a' can have or comprise a guide flange which cooperates with a corresponding guide flange on the fixture dummy in order to maintain the precise position in relation to the fixture in the vertical and transverse directions. Said arrangement thus prevents the spacer from sloping in relation to the fixture dummy during and after tightening of the fixture dummy. Upon outward parallel displacements, the flanges 7b and 7c in accordance with the above come to engage around the end surfaces of the sleeve so that vertical fixing is obtained. The inwardly projecting flange 7f is also arranged such that it permits the insertion of the threaded part of the expansion screw. The cone-shaped part 7e can have a half cone angle α of 15°, for example.

In Figure 4, a screwdriver slot is indicated by 8c and half the cone angle for the outer cone-shaped part 8b by β. Said angle β can have a size corresponding substantially to the size of the internal cone 7e in the spacer, i.e. in the present case 15°. The external thread 8a is also indicated in Figure 4.

Figures 5 and 6 show the extent of the inner surface 4a in the sleeve 4. In addition, said surfaces 4b and 4c are shown which can cooperate with the outwardly projecting flanges 7b and 7c (see Figure 3) on the expansion spacer. The external surface 4d of the sleeve is provided with a small recess in order to ensure a

good anchoring to the material of the assembly template in connection with the application of the sleeve in the template.

The invention is not limited to the embodiment described above by way of example, and instead it can be modified within the scope of the attached patent claims and the inventive concept.

PATENT CLAIMS

1. A device for determining the position of an element, for example a sleeve (4), on the one hand in the vertical direction in relation to an anchoring part or structural part, for example a fixture or fixture dummy (6), in or on a bone, for example a jaw bone, or a model (1) of a bone, and on the other hand in the transverse direction (15, 16) in relation to the longitudinal axis of the part, characterized in that a first member, for example an expansion spacer (7), cooperates both with the anchoring part or structural part and with said element, and in that a second member, for example an expansion screw (8), is designed in such a way that, when acted upon, it in turn acts upon the first member so that the latter determines the position of the element.

2. The device as claimed in patent claim 1, characterized in that the element consists of a sleeve (4) designed or intended to be incorporated in a template (1), for example an assembly template which, during its initial production, is made of yielding or elastic material which, in the final form of the template, assumes a stiffened state.

3. The device as claimed in patent claim 1 or 2, characterized in that a number of elements/sleeves (4) can each be fixed to their first and second members which consist of expansion spacers (7) and expansion screws (8), in that the template is given a shape corresponding to the shape of a jaw bone, and in that the sleeves (4', 4'', 4''') in the template are arranged to lie opposite a corresponding number of fixture dummies (6) in a model.

4. The device as claimed in patent claim 1, 2 or 3, characterized in that each expansion spacer (7) has a first part with an arrangement which determines the position of the particular sleeve (4) in the vertical direction.

5. The device as claimed in patent claim 4, characterized in that the arrangement comprises flanges (7b, 7c) which are arranged at a distance from one another and which extend completely or partially over the end surfaces (4b, 4c) of the particular sleeve to permit the height-fixing function.

6. The device as claimed in any of the preceding patent claims, characterized in that the second member comprises an expansion screw (8) which extends inside the expansion spacer (7), in that the expansion screw has an outer cone-shaped part (8b) which, when the screw acts upon the spacer, cooperates with an opposite and corresponding inner cone (7e) in the expansion spacer.

7. The device as claimed in any of the preceding patent claims, characterized in that, under the action of the expansion screw, a side wall (7d'') or side walls in the expansion spacer can be acted upon substantially radially (R) outward to assume or maintain mutual parallelism in order to bear internally or act on a corresponding inner surface (4a) of the first element/sleeve.

8. The device as claimed in any of the preceding patent claims, characterized in that the expansion screw (8) is designed so that, when acted upon, it also acts upon the expansion spacer (7) in the direction toward the part/fixture in the model.

9. The device as claimed in any of the preceding

patent claims, characterized in that a number of expansion spacers and expansion screws secured to a number of fixtures hold the template to the model of the jaw bone, it being possible to give the model the desired shape on its side facing toward the outwardly directed surface of the model, and it being possible to give the template support parts (2d, 2e) which cooperate with said surface so that the template, upon removal of the expansion screws (8) and the expansion spacers (7), acquires a precise lateral displacement position (15, 16) in which the positions of the sleeves are well defined.

10. The device as claimed in any of the preceding patent claims, characterized in that the body (2) of the template includes carbon fibre-reinforced plastic in the surrounding shell, into which curable or hardenable means can be injected and can cure or harden in order to give the template a distinct and permanent shape.

11. The device as claimed in patent claim 1, characterized in that the template (2) with associated sleeves (4, 4', 4'', 4''') can be transferred to a patient's jaw bone (14) which the model simulates, and in that the sleeves in the template then constitute guides for forming holes in the patient's jaw bone.

12. The device as claimed in any of the preceding patent claims, characterized in that each expansion spacer (7), in the position or state when not acted upon, has a circumferential dimension which permits removal of the spacer from the template via the actual sleeve, and in that each spacer determines the position of each sleeve in the position acted upon by the expansion screw in which a circumferential increase (7d''') is

thus present and the cooperation with the sleeve (4) takes place.

13. The device as claimed in any of the preceding patent claims, characterized in that each expansion spacer (7), at its parts (7i) cooperating with the respective sleeve (4), has two or more slits (7g) which extend in the longitudinal direction of the sleeve and in the wall of the sleeve continuously and preferably extend in the longitudinal direction of the spacer, which slits (7g), together with the rest of the structure of the spacer, permit radially directed displacement, with retention or adoption of a substantial parallel positioning of the outer surfaces which can cooperate with the inner surface of the sleeve.

14. The device as claimed in any of the preceding patent claims, characterized in that each spacer, at its end (7a, 7a') which can cooperate with the upper parts (6a) of the fixture dummy, has a guide flange which cooperates with a corresponding guide flange on the fixture dummy in order to maintain a precise position in relation to the fixture in the vertical and transverse directions, with the result that the spacer is prevented from sloping in relation to the fixture dummy.

Fig. 1

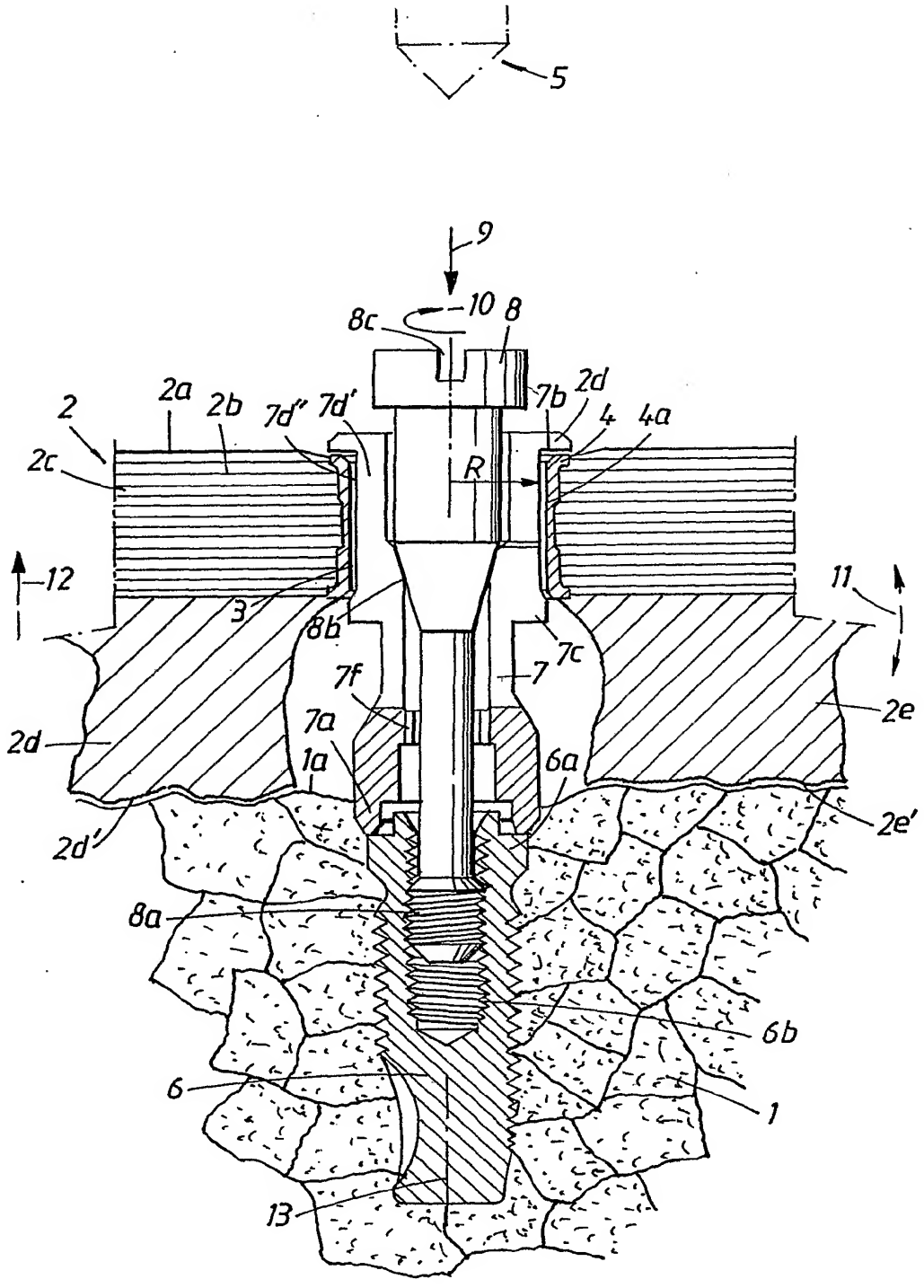

5
9
10
8
8c
2
2a
2b
7d''
7d'
7b
2d
4
4a
2c
R
12
11
3
8b
7c
7
7f
7a
1a
6a
2e
2d
2e'
2d'
8a
6b
6
1
13

Fig. 2

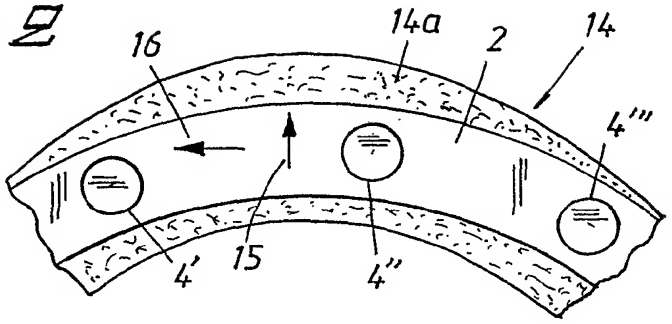


Fig. 3

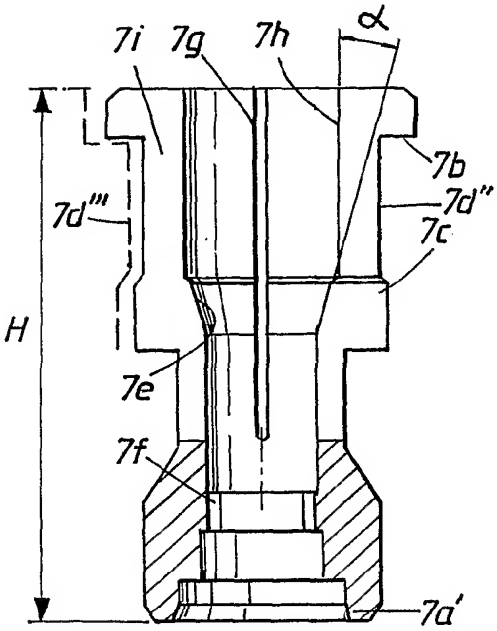


Fig. 4

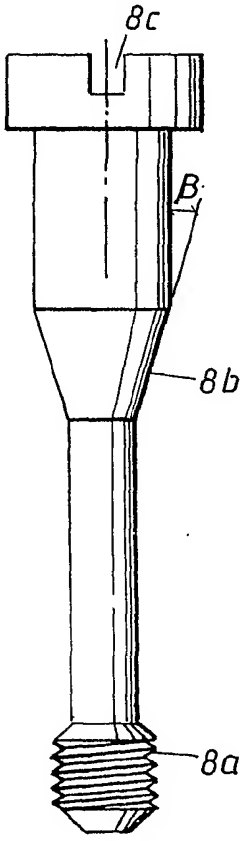
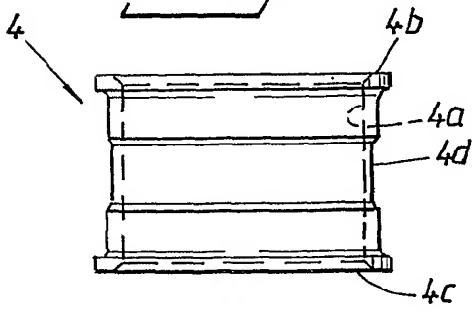


Fig. 5



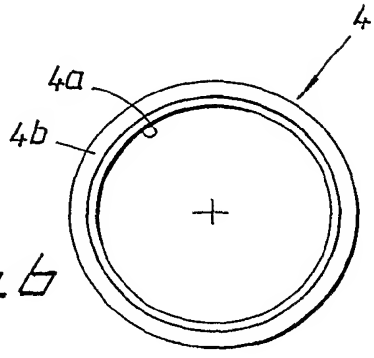


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/02900

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: A61C 8/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: A61C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0689804 A1 (NOBELPHARMA AB), 3 January 1996 (03.01.96)	1-14
A	US 4906420 A (IZIDOR BRAJNOVIC ET AL), 6 March 1990 (06.03.90)	1-14
A	US 5725376 A (MICHEL POIRIER), 10 March 1998 (10.03.98)	1-14
A	US 5876204 A (THOMAS H. DAY ET AL), 2 March 1999 (02.03.99)	1-14

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 March 2002	11-04-2002
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Jack Hedlund/Els Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

Information on patent family members

28/01/02

International application No.
PCT/SE 01/02900

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0689804 A1	03/01/96	AT 203661 T	15/08/01
		AU 697031 B	24/09/98
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		CA 2150530 A	01/12/95
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		ES 2161277 T	01/12/01
		JP 9024056 A	28/01/97
		SE 507134 C	06/04/98
		SE 9401858 A	01/12/95
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US 4906420 A	06/03/90	CA 1279963 A	12/02/91
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US 5725376 A	10/03/98	NONE	
US 5876204 A	02/03/99	NONE	